MORINGA OLEIFERA SEED DERIVATIVES AS NATURAL BIO-COAGULANTS IN WATER TREATMENT PROCESS

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SUPERVISOR'S DECLARATION

We hereby declare that we have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Master of Science.

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Air sungai di banyak tempat dalam dunia ini digunakan untuk tujuan minuman selepas menjalani beberapa rawatan. Akibatnya, kekeruhan dalam air yang tidak dirawat secara konvensional dikeluarkan dengan merawat air melalui bahan kimia mahal, yang kebanyakannya tidak mesra alam. Malah, dengan menggunakan bahan-bahan kimia dalam rawatan air mempunyai kesan negatif kepada kesihatan manusia. Oleh itu, terdapat keperluan untuk menggunakan bahan semula jadi sebagai alternatif untuk menggantikan bahan kimia. Moringa oleifera adalah tumbuhan komoditi penting yang telah digunakan untuk rawatan air di bahagian tropika di dunia. Dalam kajian ini, potensi benih oleifera Moringa sebagai bio-koagulan untuk rawatan air telah disiasat pada keadaan optimum. Eksperimen ini dijalankan dalam dua peringkat, kaedah yang pertama telah digunakan untuk menentukan saiz zarah terbaik dan jumlah Moringa oleifera benih serbuk (*MOSP*) untuk rawatan air. Ia adalah diperhatikan bahawa saiz zarah 2 mm prestasi yang lebih baik dari segi kecekapan kekeruhan penyingkiran 4.98 NTU, dengan 0.1 g. Tambahan pula, kaedah *MOSP* kedua diletakkan dalam pengekstrakan bidal untuk mengeluarkan minyak dari benih dan dihasilkan *MOCR* digunakan sebagai koagulan biologi dalam rawatan air. Kaedah gerak balas permukaan telah digunakan untuk menentukan kesan parametrik mencampurkan kelajuan, masa dan dos pada kekeruhan sisa. Ketiga-tiga faktor, seperti kelajuan yang rendah, masa kelajuan rendah dan dos disiasat menggunakan Metodologi Response Surface (RSM) untuk optimum penyingkiran kekeruhan air. Keputusan yang diperolehi daripada reka bentuk eksperimen menunjukkan keadaan optimum pada kelajuan yang rendah, masa kelajuan rendah dan dos 40 rpm, 60 min, dan 0.75 mg / L, masing-masing. Dalam siasatan ini meramalkan (teori) sisa kekeruhan adalah 4.73 NTU. Hasil daripada ANOVA untuk pengoptimuman kekeruhan sisa menunjukkan bahawa model kuadratik adalah signifikan pada tahap keyakinan 95% ($p < 0.05$). Perbezaan antara kekeruhan teori dan eksperimen menunjukkan bahawa tiada perbezaan signifikan dengan ralat peratusan 1.6913%. Kualiti air yang dirawat telah ditentukan pada keadaan optimum menggunakan ujian kualitatif. Hasil penentuan kualiti air menunjukkan bahawa kekeruhan, kekonduksian, TDS, COD dan BOD dengan masing-masing menunjukkan peratusan sebanyak 99%, 73%, 50%, 75% dan 28%. Akhirnya, keputusan yang diperolehi menunjukkan potensi Moringa oleifera sebagai koagulan semula jadi dalam rawatan berkesan air untuk tujuan minum. Kekeruhan yang lebih rendah (<5 NTU) yang dicapai daripada kajian ini mengesahkan penggunaan produk semulajadi yang mesra alam yang penting ini untuk rawatan air.

ABSTRACT

River water in many parts of the world used for drinking purpose after some treatments. Consequently, the turbidity in untreated water is often conventionally removed by treating the water with expensive chemicals, many of which are not environmentally friendly. In fact, using chemicals materials in water treatments have some negative effects to human health. Therefore, there is a need to use some natural materials as an alternative to replace chemicals. *Moringa oleifera* is an important commodity plants which has been used for the treatment of water in tropical part of the world. In this study, the potential of *Moringa oleifera* seeds as bio-coagulant for water treatment were investigated at optimum condition. The experiment was conducted in two stages, the first method of was employed to determine which of the best particle sizes and amount of *Moringa oleifera* seeds powder (*MOSP*) for water treatment. It was observed that the 2 mm particle size performed better in terms of turbidity removal efficiency 4.98NTU, with 0.1 g. Furthermore, the second method *MOSP* was placed in extraction thimble to remove the oil from the seeds and produced *MOCR* used as bio- coagulant in water treatment. Response surface methodology was applied to determine the parametric effects of mixing speed, time and dosage on the residual turbidity. The three independent factors, such as Low speed, Low speed time and dosage were optimized using the Response Surface Methodology (RSM) for optimal water turbidity removal. The results obtained from experimental design demonstrated the optimum condition at low speed, low speed time and dosage as 40 rpm, 60 min, and 0.75 mg/L, respectively. Under this condition the predicted (theoretical) residual turbidity was 4.73 NTU. The result of the ANOVA for the optimization of the residual turbidity showed that the quadratic model was significant at 95% confidence level ($p<0.05$). The difference between the theoretical and experimental turbidity showed that no significant variation with a percentage error value of 1.6913 %. The quality of the treated water was determined at optimum condition using qualitative tests. The result of the water quality determination revealed that turbidity, conductivity, TDS, COD and BOD with corresponding percentage changes of 99 %, 73 %, 50 %, 75 % and 28 %, respectively. Finally, the result obtained therefore showed the potential of *Moringa oleifera* as natural coagulants in the effective treatment of water for drinking purpose. The lower turbidity (<5 NTU) achieved from this study confirmed the potential of this important eco-friendly natural product for the treatment of water.

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